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THE NITROGEN CONTENT OF RUBBER AND ITS RELATION TO THE RATE OF VULCANISATION.

By J. Grantham.

A series of determinations of the amount of nitrogen in slab and sheet rubbers both smoked and unsmoked, having a varying rate of vulcanisation was made. Kjeldahl's method of estimation was used. The results together with the optimum time of vulcanisation for each sample are given below.

Type of rubber.	Percentage of nitrogen. (Average of two determinations.)	Optimum time of Vulcanisation in hours.
Smoked sheet.	·445	3
do. after creping.	·441	3
Smoked slab after creping.	·451	$1\frac{3}{4}$
Unsmoked sheet.	·423	$2\frac{3}{4}$
do. after creping.	·434	$2\frac{3}{4}$
Unsmoked slab after creping.	·321	$1\frac{1}{4}$

The estimation on the slab rubber was carried out on the dry crepe into which it is necessary to convert this form of rubber prior to vulcanisation. That on the sheet rubber was carried out on both the sheet itself and the crepe produced from it. No difference is apparent between the results from the sheets, creped and uncreped.

Although there is a wide difference in rate of vulcanisation between smoked slab and smoked sheet no difference is noticable in the nitrogen content. On a comparison of the unsmoked sheet and unsmoked slab however it is seen that a low nitrogen is connected with rapidity of vulcanisation.

A second series was prepared in order to confirm these results. The results are given below:—

Type of rubber.	Percentage of nitrogen.	Optimum time of vulcanisation in hours.
Thick smoked slab.	·425	$1\frac{1}{2}$
Thin smoked slab.	·398	$1\frac{3}{4}$
Thick smoked sheet.	·400	$2\frac{1}{2}$
Thin smoked sheet.	·416	3
Thick unsmoked slab.	·210	$1\frac{1}{4}$
Thin unsmoked slab.	·352	$1\frac{1}{2}$
Thick unsmoked sheet.	·386	$2\frac{1}{2}$
Thin unsmoked sheet.	·394	3

All estimations were made on the crepe prepared prior to vulcanisation. Again no relation can be traced between the nitrogen content and rate of vulcanisation in the smoked rubber and the differences are probably experimental errors. The unsmoked rubbers however show a regularly increasing percentage of nitrogen with a decreasing rapidity of vulcanisation. The increase is not regular however, the difference in nitrogen percentage between the two unsmoked slabs being much the greatest.

The loss of nitrogen in the unsmoked rubber is probably due to decomposition of the protein, and the rapidity of vulcanisation appears to be associated with this decomposition. As far as the author is aware this relation between rapidity of cure and low nitrogen content has not been recorded before, probably on account of the predominance of smoked rubbers and crepes on the market, in which the relation is not apparent. Smoking has the effect of preventing the loss of nitrogen. It does not however prevent a slab rubber developing a rapid rate of vulcanisation since the smoked slab cures in $1\frac{1}{2}$ hours. Hence it cannot be the actual loss of nitrogen which produces rapidity of vulcanisation.

In order to determine at what stage in the preparation of a slab rubber the nitrogen is lost the following experiments were carried out. First a nitrogen determination was made on an ordinary unsmoked slab which had been allowed to become dry externally. The moisture in it was estimated in two ways (1) by cutting a part into slices which were dried at 100°C, (2) by creping and drying without heating. The nitrogen was then estimated in both dry samples.

The results were as follows:—

Nitrogen in unsmoked slab calculated on 82·7% dry rubber	·307%
Nitrogen in sliced slab heated to 100°C till dry	·240%
Nitrogen in the dry crepe from the slab	·218%

There is then a large loss of nitrogen when the slab is creped previously to vulcanisation. It also appeared that most of this nitrogen is in such a form in unsmoked slab, that it is lost in the gaseous form when heated to 100°C.

The second experiment was carried further back and estimations carried out from the fresh coagulum onwards. All the percentages of nitrogen given below were calculated on the content of dry rubber. The estimation of the percentage of dry rubber in the fresh coagulum was a matter of considerable difficulty owing to the continual exudation of serum, and the result obtained from it must be regarded as approximate only. The results were as follows:—

Nitrogen in Wet slab 2 hours after pressing	·6%	(Approx.) Calculated on dry rubber.
„ „ Slab after drying for 13 days.	·324%	„
„ „ Dry crepe from slab.	·220%	———
Nitrogen in wet crepe made immediately from the wet slab.	·396%	calculated on dry weight.
Nitrogen in the above crepe when dry	·360%	———

It will be seen that there is a large loss of nitrogen during the drying of the slab. This can only be attributed partly to the loss in the serum which drains away and must partly be ascribed to loss in the gaseous form due to decomposition. That there was some loss in this form is shown by a comparison of the nitrogen content of the wet crepe prepared immediately and that of the slab after drying 13 days. There has also been a gaseous loss from the crepe during drying.

Summary.

(1) Amongst smoked rubbers from the same latex the nitrogen content is constant although the rate of vulcanisation varies considerably between slab and sheet. Smoking appears to fix the nitrogen.

(2) Amongst unsmoked rubbers from the same latex there is a considerable variation in the nitrogen content of the rubber after creping preparatory to the vulcanisation process. It is small in the case of rapidly vulcanising rubbers and larger in that of the more slowly vulcanising ones.

(3) The low percentage of nitrogen in rubber prepared as unsmoked slab is attributed partly to loss in the gaseous form during the superficial drying of the slab, and partly to the washing out of nitrogenous decomposition products when the slab is creped prior to vulcanisation.

(4) Since rapidly vulcanising smoked slab rubber contains as high percentage of nitrogen as slowly vulcanising sheets, the actual loss of nitrogen cannot be the cause of rapidity of vulcanisation, although it would appear from the results of the unsmoked rubbers that rapidity of vulcanisation and loss of nitrogen are in some way associated.

VULCANISATION EXPERIMENTS.

By B. J. Eaton.

The effect of mixing different raw rubbers.

The following experiment was carried out in order to ascertain the effect of mixing samples of rubber having different rates of cure.

Experimental.

Samples of slab rubber (124 A) having a rapid rate of cure were prepared. These slabs were allowed to stand after coagulation for the period during which the changes producing the rapidity of cure take place, which we have found to be from about 6 to 9 days. Samples of crepe (124 E) were also made which were machined a few hours after coagulation, such samples being known to be slow curing. In both cases the samples were made from latex containing approximately 1½ lbs. of dry rubber per gallon coagulated by the addition of 3 ozs. of a 5 per cent. solution of acetic acid per gallon of latex.

(N.B. Our experiments have now reached such a stage that within the limits (about 1 hour to 3¾ hours) found under our conditions of vulcanisation *i.e.* 90 parts of rubber to 10 parts of sulphur vulcanised at 140°C, we can prepare within narrow limits a rubber which will vulcanise at any particular time).

The following samples in this experiment were vulcanised and treated under the usual conditions employed by us.

Sample 124 A. Rapidly vulcanising rubber.
„ 124 E. Slowly „ „
„ 124 B. Two parts of sample A plus one part of sample E.
„ 124 C. One part of sample A plus one part of sample E.
„ 124 D. One part of sample A plus two parts of sample E.

The actual quantities taken were as follows:—

124 A. 450 grammes of sample A plus 50 grms. sulphur.
124 B. 300 „ „ A „ 150 „ of sample E plus 50 grms. sulphur.

124 C. 225 „ „ A „ 225 „ of sample E plus 50 grms. sulphur.

124 D. 150 „ „ A „ 300 „ of sample E plus 50 grms. sulphur.

124 E. 450 „ „ E „ 50 „ sulphur.

The following results were obtained on vulcanisation:—

Ref. No.	Optimum time of cure. Hours	Breaking load. Kgs. per sq. mm.	Elongation. at break (orig. length = 100)	Product.
		(*a*)	(*b*)	*a* x *b*.
124 A.	$1\frac{1}{4}$	1·46	990	1445
124 B.	$1\frac{3}{4}$	1·43	980	1401
124 C.	$2\frac{1}{4}$	1·47	963	1415
124 D.	$2\frac{3}{4}$	1·50	953	1429
124 E.	$3\frac{1}{2}$	1·39	972	1351

The optimum times of cure to the nearest quarter hour by the optimum curve method are as follows:—

124 A. 1 hour.
124 B. $1\frac{1}{2}$ hours.
124 C. $1\frac{3}{4}$ „
124 D. $2\frac{1}{4}$ „
124 E. 3 „

As will be seen the relativity of the samples is approximately the same by both methods.

Remarks and conclusions:—The above results show the gradation in rate of cure according to the proportion of fast or slow curing rubber in the mixture. The mechanical or physical properties of all the samples are very good and as far as can be judged from breaking point figures the different samples are equal in this respect.

The experiment gives results which are of importance both from the producers' and manufacturers' point of view, since it comfirms the probable reason given by the writer for the uniformity of Fine Hard Para, viz. that this uniformity was due to averaging. A ball of Fine Hard Para rubber consists of latex collected on different days for a period of several months, so that any daily variation in the latex or the method of preparation is averaged and one ball of Fine Hard Para would be very similar to any other ball. The experiment also indicates a method which could be adopted on any estate to obtain similar results, if it is found, as we know to be the case, on some estates, that the rubber prepared on different days varies considerably in rate of cure and behaviour on vulcanisation. The method has considerable advantages from the manu-

facturers' point of view since, by its adoption, uniformity in respect to rate of cure, at any rate, is more likely to be obtained than by any other method, unless methods of preparation on estates are kept very rigid. The chief disadvantage, and this occurs in connection with other products, would be in sampling and testing, *e.g.* if each box containing rubber prepared on different dates, were sampled by taking a sheet or two from each, these sheets might not represent the bulk, and the only satisfactory method would be to rework the whole together and to test the mixed sample. The problem of sampling rubber for testing purposes will probably be complex. Schridowitz in recommending a Testing Station and Scheme to the London Committee of the Rubber Growers' Association has suggested the testing of half ton lots which would be approximately one box in five or more. It appears to the writer that it is quite possible that this, especially in the case of sheet rubbers, may not by any means represent the bulk even in the case of rubber from one estate and that much more investigation is required first, by examining a large number of samples of different shipments from any estate. The only satisfactory method, before such a scheme is inaugurated, is that each estate should have several tests carried out on samples from each shipment as a preliminary, in order to see what the actual variation is likely to be. The preference of some manufacturers for the rubber from particular estates is probably due to the experience already gained by such manufacturers and the knowledge that the rubber from such estates is always uniform in respect to its behaviour on vulcanisation.

As has been pointed out in a previous paper (vide Agricultural Bulletin Vol. iii No. 10 July, 1915 pages 398-401) in the case of thin crepes, prepared on the same day as coagulated, great uniformity exists, but in the case of sheet rubbers, unless methods of preparation are very rigid, there is likely to be much more variability in respect to rate of cure. Obviously the methods of bulking latex and the greater control of dilution of latex and amount of coagulant, and subsequent treatment in estate factories have tended to much greater uniformity in this respect than was the case a few years ago and on any particular estate the rubber prepared at different times is probably very uniform, the greatest differences occurring between rubbers from different estates, so that the manufacturers' complaints of lack of uniformity in plantation Para rubber as a whole are still justified.

SEEDS—ALIVE OR DEAD?

Speaking generally the life of a plant has two distinct phases. the one a period of activity and the other a period of rest, these alternating a number of times according to the "nature" of the individual, finally ending in the condition which we describe as death. The period of activity is, in the case of an ordinary green plant, the period when the green leaves and roots are functioning to their utmost, working in preparation for the execution of the inimitable trick of "resting" which we find achieved in the confined space of its seed. This trick of seed-formation is quite unique for by its means the plant has solved the question of carrying on in the confines of the smallest space, under self-made preserving conditions the possibility of reproducing individuals like itself. The Philosophy concerning the Primrose might well apply to a single one of its seeds, for here, if in any part of nature, we meet with a fundamental problem of life itself.

Seeds have been described as amenable things. For most part they produce that which is in them to order, with little difficulty to the husbandman. Given proper conditions of temperature and moisture the living seed will awake from its rest with high average certainty. Yet the facts of experience shew us that certain classes of seeds have, like all individuals, idiosyncracies which dictate methods of manipulation if they would individually be made to reveal their secrets. What these idiosyncracies are we need not dilate upon except perhaps to indicate that from the economic point of view there are two of importance, included under the items "dormancy" and "longevity."

Now it is natural that the seed presenting one of the enigmas of life with such an approach to uniformity, should have stimulated inquiry into its "modus operandi." How is the potential living tree provided for in the seed? Is the seed actually living and only sleeping in that life processes are constantly going on in a reduced amount, or, are all life processes suspended awaiting some extra stimulation to set them a-going. In other words "Is the state of rest real and absolute or only apparent. May the seed be compared to a clock wound up and only requiring the push of a pendulum to set it a-going or is quiesence in the dry seed not really due to abolition of vital processes, but only to a diminution of these to such an extent, that they cannot be recognized?"

Towards elucidating this matter many and various are the attempts which have been made. Resting seeds have been given such sorts and conditions of treatment that would knock life—such

as we know it to be conditioned—out of anything. Poisons, intense cold and dessication are among the "barbarities" which have been employed. Thus:—

Romanes kept seeds in ether and ammonia and absolute corrosive for months and still they came up smiling. From this he concluded that all life in the seed was suspended only to find himself questioned by Bequerel, who, experimenting on Peas, Lupins and clover shewed that in these cases at any rate the seed coat was an armour, preventing, in its dry condition, the entrance of the poisons.

Adams, working on peas, flax and barley etc: with liquid air, concluded that there was no mimimum temperature for dry protoplasm, abnormally low temperature only having effect when disintegration changes were set up through water and gas being present in the seed.

Thus directed, have we any knowledge that the actual processes of life are being gone through in the resting seed? Does the dry seed respire? As to whether this is so seems an undecided matter but as far as we are concerned here, the answer is possibly given by the result of the work of Kolewitz, who claims to have shewn that respiration is not essential for the continuance of vital capacity. It is to be noted, however, that his conclusions have been much questioned—nevertheless evidence, such as we have, seems to point to the fact that unlike the hibernating animal whose vitality is slowed down during the periods of the animal's inactivity—the "resting seed" is in a condition of what is described as "static equilibrium" that is, that the functions ordinarily associated with life are actually suspended and await the stimulus—we know not of what—to shew themselves.

The natural corollary to this seems to be that the dry seed is endowed with possibilities of the "life eternal." The experiments started by Bequerel will be of value towards elucidating this. At present we are aware of the existence of seeds of extreme longevity. The mummy-wheats are more than possibly "fairy tales," nevertheless, we know of the existence of seeds which retain their vitality for very long periods. These for the most part are hard coated seeds whose very protection seems to be their water and gas-tight seed-coats.

The variations in the periods of dormancy and longevity are facts of common experience. Conditions of ripeness at time of harvest, subsequent complete drying and storing in dry atmosphere are perhaps the more important of the factors on which these attributes depend. As concerns the conditions of harvest we know that some plants produce one batch of seeds—their first harvest—which germinate at once and then a second crop requiring a longer period of rest. Among these comes the familiar golden chain, (Cytisus laburnum.)

Percival states that it is inadvisable to use seed of wheat, maize, cabbage and most grasses after periods of storage of 2-3 years. After this period death ensues.

But we meet with a type of seed diverging widely from these. Some conifers do not even germinate for several years: some of the seeds of our English trees require frost before they will commence their activity and so on. The most instructive of the experiments done heretofore in the direction of elucidating the question of real longevity are those of Bequerel, who describes the results of seeds of 30 families and 350 species in all, stored for 25-135 years. The results shew that of seeds of 25 years storing not one of those belonging to the orders Graminaceæ, Liliaceæ, Urticaceæ and Polygonaceæ germinated, but the record was obtained by three species of leguminous plants whose seeds after 80 years storing germinated. These be it noted had hard impermeable seed coats.

Now this question has economic significance of some magnitude. Rose, in a paper attempting the solution of practical problems of the seedman and grower, describes hot water, various chemicals, such as sulphuric acid and various mechanical appliances—notably the machines of Nilsson, where seeds are thrown against the concave surface of a rough stone or against a bank of needles—as devices of man to produce a greater germinating power and a greater germination-speed of these self-protected seeds.

The work of Shull on this question of longevity is described in the Gardeners Chronicle for 27th September this year (1915). A pond undrained for 70 years was drained, and in a few months a most luxuriant Vegetation of 140 Species of flowering plants was found.

This prompted an enquiry into the provenance of this flora and experiments were started in 1905, in which year 6 jars with seeds submerged in earth and supernatent water were put away, water being added to make up evaporation as required. After 18½ months it was found that the following germinations took place: Cyperus spp; Juncus tenuis, Meuhlenbergia diffusa and others: in 2½ years Lappa minor formed in addition to the then germinating seeds, and after 7 years germination took place with Sium acutifolium and 2 species of Juncus.

Now it will be seen in comparing this latter with what has been mentioned previously that we have two distinct problems. The one, the dormancy and retention of vitality of dry seeds and the other, that of moist seeds. As concerns this latter our knowledge has received a tremendous step forward from the work of Kidd on "The controlling influences of carbon dioxide in the Maturation, Dormancy and Germination of Moist Seeds."

Kidd shews that carbon dioxide in the tissues of the seed may be held responsible for delayed germination. Further that the carbon dioxide acts as a narcotic in that its effect is transient and does not result in injury.

His inquiries and results are of very great importance and interest. Working with Hordeum vulgare, Pisum sativum, Vicia faba, Brassica oleracea and Allium crepa, he shewed that all these under proper conditions as concerns water and temperature, would not germinate in atmospheres containing certain percentages of carbon dioxide, but that they came from their stupor unscathed when given back their proper conditions.

Continuing his inquiries he found that Brassica alba presented a still more peculiar phenomenon, in that the subsequent revival did not take place as expected—the seeds appearing to sulk after their treatment and only germinating after coaxing by special devices. This latter effect—the prolongation of narcosis—he proved to be due to the seed coat retaining the additional carbon dioxide and preventing its escape for, by removing the testa, he was able to eradicate the delay and bring the germination time to normal. Similarly by drying the seeds for 3 weeks or by immersing them in chloroform water for 70 minutes, he was able to produce the same effect. In his experiments, Kidd imitated what actually must occur in nature in cases of delayed germination, and in passing it may be noted that he solved the problem confronting Shull. In inquiring into the sequence of events which go on in nature he placed a number of bags of seeds of Brassica alba at various depths in the soil of a pit wherein he caused by natural processes—through the agency of decaying grass placed at the bottom of the same, the production of a carbon-dioxide atmosphere. The result of his investigation in the field shewed complete accordance with those obtained in his laboratory.

Now this matter is of the greatest importance agriculturally especially as concerns the question of green manuring. Results of work in India shewed that tobacco seed completely failed in germination if sowed soon after the crop of green manure (Crotalaria) was ploughed in. Also Java indigo planted 30 days after the ploughing in of Crotalaria gave similar failure. Kidd's further work suggests the complete explanation of these failures, for he shews that decreasing the free oxygen content of the "germination atmosphere" causes an increase in the inhibitory power of the carbon dioxide. Thus the reviewer of this work writes:—

"From the point of view of Indian Agriculture, Mr. Kidd's investigation suggest a line of work in connection with green-manuring which is almost bound to yield useful results. Experiments on this subject at Pusa show conclusively that green-manuring for cold season crops only gives positive results on light, well-drained soils when the interval between ploughing-in the green manure and planting the next crop is about eight weeks. On heavy lands or on lands which are waterlogged from any cause, green-manuring leads to a smaller crop than that on control plots. Shortening the time between ploughing-in the green manure and planting the next crop gives reduced yields similar to those on heavy or waterlogged land. That these results are, in all probability, connected with the supply of oxygen in the soil is suggested by the effects obtained last year at Pusa in subsoiling after green-manuring."

The actual physiological effect of the carbon dioxide is described as one of true narcosis. It has been shewn that 7% of carbon dioxide depresses the growth of roots. Further that the general behaviour of these agents in small quantities is to stimulate. This is proved by Kidd's experiments on Hordeum and Brassica germinated in the dark.

It is perhaps worthy of note that Rongten Rays behave in a somewhat similar way on dry seeds, accelerating their germination after slight exposure, retarding growth if the exposure is too long or intense, and here too the effect may remain latent for some time.

From Mr. Kidd's work several points in Tropical Agriculture suggest themselves. The question of green manuring has been already touched upon; but further it may perhaps now be assumed that the common unfortunate experience of the padi planter, to whom the late cutting of the weeds spells failure and pecuniary loss, is due to the excess of carbon dioxide produced in his "unripe manure." Also the particularly interesting puzzle of rubber seeds whose viability has proved to be of such short duration seems now to be solved. It is shown that this seed has a highly permeable seed coat, that it is intolerant of drying and that it has a high water-content. 40-50 of these seeds in 1200 c.c. of air were found to set up an atmosphere containing 40-45% of carbon dioxide and this atmosphere was found to effect a prolongation of life.

From Kidd's results we may perhaps assume that the rapid falling off of the germination of rubber seed is a fact which may be eliminated to order:

"The favourable results obtained in these experiments in prolonging the vitality of these rapidly deteriorating seeds were greatly in excess of those which are secured by present commercial methods of packing for transport and import. In experiments on a large scale the seeds might be simply sealed (in the proportion of air mentioned) in large carboys, such as are used for the transport of distilled water, covered with wicker or wire netting. In case of too high an internal pressure, arising from overfilling with seeds, a simple form of safety valve might be inserted in the sealing."

In commenting on the significance of this addition to our knowledge we find some instructive reading in the pages of the Gardeners' Chronicle, where the possible importance of this to the seedsman and collector are emphasized. Further the method is so full of suggestions that it appears possible that the horticulturalist may become an even more subtle conjurer, changing for example the periodicity of first, second and third earlies etc: in such crops as peas. But to return to the original question we still await the result of science to expound to us the riddle of the dry resting seed.

G. E. C.

NOTES ON A PLANT KNOWN BY MALAYS AS THE "CHAT" TREE.

By F. G. Spring.

Information received by the Department of Agriculture indicates that small holders in the districts of Jelebu, Kuala Pilah and Tampin are buying to some extent seeds of a plant known to them as the "Chat" tree. In the above districts the seed is being sold at very high prices such as forty dollars a gantang, and proportionately large sums for small quantities have been paid. It would appear that the buyers are under the impression that the tree produces rubber of superior quality and of much greater value than that obtained from Hevea.

Seeds and leaves received by the Department have been examined and it is practically certain that the "Chat" tree is the ordinary Ceara rubber (Manihot Glaziovii). This note is written as a warning to those who may think of taking up its cultivation since it has proved of little value, in this country, as a planted crop compared with Hevea.

The seeds of Ceara are similar in appearance to those of the castor oil plant. They take a long time to germinate unless the

hard outer covering is abraded or soaked in warm water for some time. The tree is a rapid grower but attains only medium height and has a spreading habit. The leaves, generally five lobed have a bluish grey colour and the bark is silvery like that of the birch. The plant thrives in places unsuited to most cultivated plants. It would appear to be adapted to a climate drier than that of Malaya.

The following is an extract from the Agricultural Bulletin of the Malay Peninsula, No. 7, June, 1897. "Manihot glaziovii, Ceara scrap rubber, has attracted a great deal of attention in past years, and many trees were planted in Ceylon and elsewhere. The amount of rubber produced under cultivation was so small, and the profit so slight that the Ceylon planters destroyed their trees, and abandoned the cultivation. In the Peninsula, trees were planted in many places, and though isolated trees are to be found as fine as could be wished, the greater part utterly failed. This habitat of Ceara rubber trees is one of the driest of the Brazilian provinces, where the soil is sandy or gravelly or even rocky, where even tapioca requires to be watered, and there are occasionally years when no rain falls. In fact the tree is a regular desert plant. What wonder then that it should not be successful in a wet climate like ours?"

Mr. J. W. Campbell, late Superintendent Government Plantation, Perak, writes in the Agr. Bull. S. S. and F. M. S., Vol. V, No. 5, May 1906, "The Ceara is not a tree for the Malay Peninsula. It does well in a young state and up to 20-25 years, when it begins to show signs of decay and in a year or two dies right off. I do not know why this should be, but have heard it suggested that the excessive rainfall of the Peninsula does not suit it. One of the oldest trees at Kuala Kangsar is now going off in this way."

SUMMARISING REPORT ON LOCUST WORK FOR THE SECOND QUARTER.

April 1st to June 30th, 1915.

General.

The locust work during this period was continued successfully, destruction of hoppers being confined to the Negri Sembilan and Johore as a few flying swarms alone were present in Selangor. The locusts have been so successfully destroyed in this latter State that there little work was necessary, and the Special Assistant Mr. Lyford

was able to supervise the destruction work in the Seremban district of the Negri Sembilan in addition to his duties in Selangor.

In June the Special Assistant Mr. Wolde was appointed Acting Manager of the Government Plantation at Pondok Tanjong and his place in the Tampin district was taken by Mr. J. O'Brien.

Selangor.

During this quarter the locust work in Selangor was lighter than in any previous quarter since the commencement of the campaign. No destruction work was necessary and it was a simple matter to keep the 3 or 4 flying swarms present under observation. None of them shewed any signs of laying eggs.

In April, at the commencement of the quarter there were four flying swarms in the State, at Petaling, at the 37th mile Sepang Road, at the 7¾ mile Sungei Besi Road, and at the 13th mile Serdang Road respectively. These all went into the Negri Sembilan during the month. Subsequently two returned, one to Bangi and one to the jungle between Sungei Besi and Bukit Jalil Estate. During the month of May another swarm appeared and at the end of the month the three were located as follows: One at Bukit Jalil Estate, one at Sungei Lalang and one near Kuang. During June the swarm from Bukit Jalil moved to the Serdang, Batu Tiga Road and remained in the Petaling district during the month. The Sungei Lalang swarm went back into the Negri Sembilan and bred in the Labu valley; the resulting hoppers were successfully exterminated by the Special Assistant, Selangor. The swarm at Kuang remained there, gradually diminished in size and it finally disappeared without laying eggs. Either it died out or else the remnant joined with the Petaling swarm. Ultimately, therefore, at the end of the quarter there was only one flying swarm present in Selangor and even this had originally come in from the Negri Sembilan.

Work in the Negri Sembilan.

Locusts have been mainly confined to that portion of the State south of a line drawn from Ayer Kuning to Seremban, being most prevalent in the Mukims of Ayer Kuning and Rembau and in the whole of the Coast District. Towards the end of the quarter several swarms deposited their eggs throughout the Labu valley and along the Setul Road. The resultant hoppers were successfully destroyed by the Special Assistant from Selangor sent down for the purpose. The number of locusts in the Tampin and Coast districts appears to remain fairly constant, but they have been successfully eradicated in the country around Seremban.

Coast District.

The work in this district was continued without cessation throughout the quarter, making a continuous 6 months destruction work. The locusts were scattered throughout the district, Sua Betong proving to be the chief breeding ground. The large lalang stretches around this estate are attractive feeding and breeding places for all swarms moving along the coast in a northerly direction. Where there was sufficient herbage poisoning was carried out; on bare soil the bag-trap method was used. The swarms driven numbered 83 representing 432 tins, while 814 swarms were poisoned, making a total for the quarter of 897 swarms of hoppers destroyed. For the half year ending June 30th a total of 1478 swarms were exterminated.

Tampin.

In this district the work begun at the end of the previous quarter was continued until May 23rd when all the hoppers had either been destroyed or had developed into fliers. Hoppers matured at only three places Gemencheh, Keru and Kundor owing to the fact that the reports of their presence were received too late or to the difficult nature of the country. Scout coolies employed on the completion of the destruction work in May reported breeding grounds at the end of June and shortly afterwards hoppers were found throughout the Gemencheh and Ayer Kuning Mukims. The total number of swarms destroyed by the poison method which alone was employed was for the quarter 496, making a total for the breeding season from March 9th to May 23rd of 597 swarms.

Seremban District.

Destruction of those hoppers which had appeared in the Labu Valley at the end of the last quarter was commenced on April 1st and successfully finished on May 26th. About the time this work was completed several flying swarms reached the Labu Valley and others appeared on the Setul Road. Some of these were believed to come from the direction of Kuala Pilah and others from Mambau. These swarms deposited eggs on several estates in these vicinities and 26 breeding grounds were discovered, mainly in the Labu Valley. The destruction of these hoppers commenced on June 16th and was actively continued until the end of the quarter when the work was nearly completed. At the end of the month a swarm of fliers moving northwards divided into 2 halves of which one half laid eggs again in the Labu Valley and on Temiang Estate and the other half bred at Mambau. At the end of June hoppers were destroyed by the

bag trap method at Ulu Sawah where the number of cattle made it inadvisable to use poison. In the Seremban district a total of 130 swarms representing 2462 tins were driven and 232 swarms were poisoned making a total of 362 swarms for the quarter.

JOHORE.

As was stated in the report on the 1st quarter's work hoppers appeared at the end of March in the four centres where eggs were laid, namely Tangkah, Jorak, Sungei Mati and Batu Anam.

At Tangkah work was continuous from March 28th to June 7th The driving and poisoning methods were both used according to the nature of the ground. A few flying swarms escaped. In the middle of June when the work on the previous generation had been nearly completed, old flying swarms came in from Malacca, depositing their eggs in 18 distinct places around Tangkah. The hoppers hatched out before the end of the month and destruction work on them was commenced on June 30th. The total catch for the period March 28th to June 30th was 128 swarms driven representing 412 tins and 74 poisoned, making a total of 202 swarms dealt with.

In Jorak district work was commenced on April 2nd and continued until May 28th, it was chiefly confined to preventing the hoppers from seriously damaging the young hill padi at Blemang. Both the poisoning and trapping methods were employed with success and the owners of the padi took much interest in the work and gave every assistance. Practically no hoppers escaped as fliers, but a few swarms of fliers came into the district from Tangkah in May. These remained in the vicinity of the river and flew between Jorak and Bukit Kepong until the end of the quarter; at that time there were 5 flying swarms in all. The total catch for the season was 162 swarms driven representing 426 tins and 199 poisoned making a total catch of 361 swarms.

In the Sungei Mati district work commenced on April 3rd and concluded on June 6th, only 3 swarms escaping. The poisoning and trapping methods were both used and attention was chiefly paid to saving the dry padi which is common in the district. The total catch amounted to 13 swarms driven, representing 38 tins and 113 poisoned making a total of 126.

Though hoppers were present in the Batu Anam district at the beginning of April, the difficulties of obtaining labour prevented a start being made with the work there until the 28th. All the hoppers were destroyed by May 30th, but, unfortunately, the delay allowed certain swarms at Kabun Bahru to escape, as the gang could not move there in time. A mature flying swarm appeared at Kabun

Bahru in June and moved first to Jementah then to Batu Anam and finally to Buloh Kasap portions of the swarm laying eggs at various places on the way. Arrangements were made to commence destroying these hoppers early in July. The total number of swarms poisoned during the season was 48.

The results of the work in Johore during this season were on the whole satisfactory. At the end of June 9 flying swarms were present of which 3 were at Sungei Mati, 5 along the Muar River and 1 at Kabun Bahru. This total is about the same as that at the beginning of the season, but in the interval several flying swarms had entered Johore from Malacca and some of these are included in the total given. It must also be borne in mind that three factors hindered the smooth progress of the work. The most important was the heavy local rains especially in the month of April which prevented in certain districts the poisoning from being so successful as it is in dry weather. In other localities a lack of water complicated the field conditions, while in Batu Anam labour difficulties retarded the progress of the work by about 3 weeks at a critical time. The utility of the work can readily be gauged in this instance from the fact that the hill padi crop was almost entirely saved from threatened destruction in an area where the Malays are very dependant on the produce for their food supply and where their anxiety as to the fate of the crop was shown by the manner in which they assisted the Assistant Agricultural Inspector in the destruction of the hoppers. It should be recorded that the hoppers which were present at intervals along the line Tangkah, Paya Mas, Sagil, Blemang, Ayer Panas, Kabun Bahru, Jementah and Buloh Kasap representing a front of about 30 miles, were all within 10 miles of the northern boundary of Johore.

Summary.

Reference to the table of results will show that only 197 swarms have required to be dealt with in Selangor during the first half of this year and it is probable that the offspring of only one or at the most two flying swarms will require to be dealt with in the coming 6 months. For the same period during 1914 a total of 1241 swarms of hoppers were destroyed, a fact which marks a large reduction in the numbers of locusts during the 1st half of 1915. At present in Selangor the position may be considered entirely satisfactory.

In the Negri Sembilan, however the position remains very much as it was during the corresponding period of last year. For the first half of 1914, 1832 swarms were destroyed. For the same

period of this year 2,240 swarms were dealt with, showing an increase of 408 swarms. It is probable that this increase in the number of swarms destroyed this year is due rather to an extended use of poison accompanied by increased efficiency than to an actual increase in the numbers of locusts present in the State. A consideration of the position in the Negri Sembilan shows that the problem of exterminating the locusts has been reduced to the question of dealing successfully with hoppers produced in large numbers in the wide lalang lands around Tampin, in which district the majority of the locusts in the Peninsula are now concentrated. The successful extermination of outlying swarms is a simple matter. Two matters of considerable importance during the first half of 1915 are the material reduction in expenditure on and the increased efficiency of the work during this period as compared with the corresponding period of 1914. The total expenditure for the 1st half of 1914 was $49,209.58 and for the corresponding period of 1915 $23,898.02 representing a saving of $25.311.56. While this saving probably represents a certain amount of the capital expenditure for 1914 the total actual saving on working expenses for the first half of this year is certainly not less than $15,000. This saving can be attributed partly to the use of poison, but mainly to the reduction of the number of locusts present in Selangor. The destruction work has been successful in one other particular namely that it has prevented the locusts from causing any damage to crops during the first half of this year.

LOCUST WORK— TABLE OF RESULTS— JANUARY—JUNE 1915.

State	District	Period	Big-trap Method		Poison Method	Total Swarms
			Swarms	Tins	Swarms	
Selangor	Sungei Besi Road	Feb. 9th -March 21st	197	4633	...	197
Negri Sembilan	Coast District	Jan. 1st—30th June	218	987	1260	1478
	Tampin District	January	...	...	3	3
		March 9th—May 23rd	...	...	597	597
	Seremban District	April 1st—May 23rd	113	2251	119	232
		June 16th—30th	17	211	113	130
Johore		March 28th—June 6th	322	908	434	756
Total Catch	F. M. S. and Johore	January 1st to June 30th.	867	8990	2526	3393

	Locality	Period	Swarms driven	Tins	Swarms poisoned	Total Swarms
Selangor	No Hoppers Present					
Negri Sembilan	COAST Sua Betong, Rantau. Tampin Linggi, Leigh Estate and Nytoh, LubokChina Rd. Kanchang Lukut Estate Sirusa Estate St. Leonards	April, May and June	83	432	814	897
	TAMPIN Jeu and district Ayer Kuning Gemenche Keru Kendong to Rembau Pedas, Kundor	April and May			496	496
	SEREMBAN Labu Valley and Setul Road	April 1st—May 23rd June 16th—30th	113 17	2251 211	119 113	232 130
Johore	Jorak	April 2—May 28	102	426	199	301
	Sungei Mati	April 3—June 6th	13	38	113	126
	Tangkah	April 1st—June 7th and June 30th	... 128	... 412	... 74	... 202
	Batu Anam	April 28—May 30th	...	...	48	48
	Total.		456	3770	1976	2432

THE DISEASES OF TROPICAL PLANTS.

By M. T. Cook Ph. D.

Professor of Plant Pathology, Rutgers College N. J.

(McMillan & Co. London.)

No one is likely to dispute the value of a reliable book dealing with the diseases of economic tropical plants, but the impression produced by the present work is that the opinion quoted in the preface is correct; viz, that no one man is capable of writing such a book. No one man can hope to deal authoritatively with crops other than those under his personal observation; the remainder of the book must be a mere compilation from literature which is too often scanty, and characterised by the absence of references.

The book starts with a definition of a diseased condition as one in which the plant is not functioning in the normal manner; thus making 'disease' a very far reaching term, ranging from insect, fungus, and bacterial agents, to soil and weather conditions. The author however, deals almost entirely with fungoid and bacterial pests.

After a short general account of the structure of higher plants and a few typical fungi, the author passes to a chapter of considerable length entitled "Classification of Fungi," in which a few of the more important fungi in each group are described.

In the more important part of the book the crops are taken separately, and the diseases of each described. It is here that the defects of the work are most apparent. The general attitude is too often that expressed by the following statement. "There is considerable difference of opinion as to the fungus..... but after looking over the literature carefully, the writer has decided to refer it to *Colletotrichum falcatum* Went, although not sure that this is correct." One would have thought that a certain amount of practical work would have been considered essential for the expression of even a tentative opinion.

The section on Hevea diseases is limited to six pages. Starting with the statement that 'Canker' is one of the commonest diseases of rubber trees, the author goes on to state that is caused by a species of *Nectria,* which attacks trees in the Straits, Ceylon and the E. Indies. In point of fact, 'Canker' has not yet been found for certain in the F. M. S., and in those countries in which it occurs, Nectria as a cause has definitely been discredited—the latest view

being that the "Canker" of Java and Ceylon is caused by Phytophthora Faberii. It is easy to find Nectria Sp. on attacked wood, but it seems invariably to be saprophytic.

The author distinguishes *Corticium Zimmermannii and Corticium Javanicum* as two separate diseases, but according to the latest work (Brooks and Sharples Bull: No. 21—Department of Agriculture F. M. S.), these are identical, and the name *Corticium Salmanicolor* is preferable, or as it known locally 'pink disease.'

The article on "Die-back" does not make it clear that the fruit bodies usually found on attacked branches are those of a species of *Diplodia;* only in a single case has a connection with the fungus *Thyridaria* been suggested.

There is a short account of *Fomes,* followed by a brief mention of other fungi. No attempt is made to distinguish between those of economic importance, and others of scientific interest only. *Sphaerostilbe repens* is mentioned but not described, and *Ustulina Zonata* is not even mentioned.

The section dealing with Cocoanut Disease appears to be of considerable merit, dealing as it does with a crop with which the author is doubtless familiar—the only diseases mentioned which are of importance locally are *Pestalozia Palmarum*, and perhaps, "bud rot."

At the end of the book is an interesting section on entomogenous fungi; the uses of which in the control of various insect pests has received attention all over the world, with somewhat disappointing results.

Chapter IX on "Prevention and Control" is wholly good, and the opening paragraph deserves quotation: "Success depends not only on the intelligence and progressiveness of a few individuals, but upon the patriotism of the populace. Although the individual working alone can accomplish enough to amply repay for the time, labour, and money expended in much of this work, the greatest good to the largest number will be accomplished by co-operation—co-operative work not only in the treatment of these pests, but in securing the enactment and enforcement of necessary laws."

The last chapter contains some useful recipes for spraying mixtures, and directions for their application, but, in this connection the author's remark as to the uselessness of spraying when once fungal hyphae have penetrated the tissues of the host plant should be borne in mind.

In conclusion, this book written as it is in the Western Hemisphere, can scarcely be of great value locally, and emphasises the need for a series of reliable monographs on tropical diseases written by men on the spot. W. N. C. B.

Exports of Rubber from British Malaya (other than the F. M. S.)

State	Month	Quantity
Johore	August 1915	lbs. 1,723,175
Kelantan	August 1915	lbs. 112,031½
Kedah	....	....
Perlis	August 1915	lbs. 95
British North Borneo	August 1915	lbs. 204,042
Brunei	August 1915	lbs. 8,193

FEDERATED MALAY STATES.

Comparative Statement of Cultivated Rubber Exported, with Value and Duty Collected Thereon, During the Years 1915 and 1914.

Destination.	Exported during September, 1915.	Previously.	Total export during the year.	Export during similar period of previous year.	Increase.	Decrease.	Value of rubber exported, 1915.	Duty collected, 1915, to date.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	$	$ c.
Straits Settlements ...	2,860.55	17,577.14	20,437.69	12,696 41	7,741.28	...	40,546,672	
United Kingdom ...	1,081.21	8,531.80	9,613.01	7,434.34	2,178.67	...	19,018,991	
Continent of Europe...	...	8.00	8.00	807.78	...	799.78	15,880	
Ceylon	42.73	461.09	503.82	535.63	...	31.81	995,729	
Other Countries ...	...	95.07	95.07	100.27	...	5.20	181,447	
Total ...	3,984.49	26,673.10	30,657.59	21,574.43	9,919.95	836.79	60,758,719	1,572,247 93

KUALA LUMPUR,
6th October, 1915.

F. J. WELD,
Acting Commissioner, Trade and Customs, F.M.S.

Abstract of Meteorological Readings in the various Districts of Malaya for the month of September 1915.

DISTRICT.	Mean Barometrical Pressure at 32° Fah.	Maximum in Sun.	TEMPERATURE.				HYGROMETER.				Prevailing Direction of Winds.	Total Rainfall.	Greatest Rainfall during 24 hours.
			Mean Dry Bulb.	Maximum.	Minimum.	Range.	Mean Wet Bulb.	Vapour Tension.	Dew Point.	Humidity.			
Kelantan, Kota Bahru ...	...	137.1	82.1	91 2	73.7	17.5	77.1	.832	73.7	75.	...	10.06	1.56
Pahang, Kuala Lipis ...	...	...	80.2	89.7	73.2	16.5	75.3	...	...	...	...	7.92	1.54
Johore, Johore Bahru ...	...	...	...	88.07	73.75	14.32	...	...	...	...	...	7.40	...
Singapore, Kandang Kerbau	29.801	160.	83.1	88.2	74.7	13.5	77.7	.874	...	78.	...	5.40	1.36
Malacca, Durian Daun ...	29.796	148.6	82.1	87.4	70.4	17.0	79.3	.963	...	92.	N.W.	6.00	1.36
Negri Sembilan, Seremban	...	151.5	85.8	87.1	72.	15.1	75.9	.838	73.7	84.	N.W.	5.53	1.74
,, Kuala Pilah ...	..	155.0	80.3	89.1	73.	16.1	79.6	.850	74.2	83.	N.W.	5.07	1.65
,, Port Dickson	...	120.3	81.4	87.9	73.9	14.0	77.3	.860	74.6	80.5	N.W.	10.95	3.23
Selangor, Kuala Lumpur ...	29.821	138.2	80.3	85.8	75.5	10.3	77.3	.830	75.5	86.	S.E.	8.15	1.90
,, Klang ...	...	...	80.2	85.6	74.0	11.6	76.3	...	...	...	...	3.61	1.65
,, Kuala Selangor ...	...	..	...	88.8	75.0	13.8	...	...	...	...	...	6.12	1.60
,, Rawang ...	...	...	...	90.0	74.0	16.0	...	...	...	...	...	5 43	1.03
Perak, Telok Anson ...	...	...	82.33	93.	70.	23.	77.90	.898	...	83.	...	9.08	2.20
,, Ipoh ...	...	...	82.81	94.	71.	23.	77.22	.861	74.48	77.	...	11.00	2.90
,, Taiping ...	...	157.	81.28	93.	72.	21.	77.29	.884	...	85	...	19.24	3.77
,, The Cottage ...	...	...	...	...	...	...	...	...	...	...	...	20.88	4.34
,, Parit Buntar ...	...	...	82.73	92.	71.	21.	77.86	.889	...	81.	...	15.80	3.56
Penang, Georgetown ...	29.807	138.4	81.4	87.1	73.0	14.1	77.0	.877	74.7	82.3	...	12.69	2.19
Kedah, Alor Star ...	...	...	...	...	...	...	...	...	...	...	...	17.91	2.42
Perlis, Perlis ...	...	...	...	...	...	...	...	...	...	...	...	8.95	...